Bioscience Research Communications
Vol. 15, No. 2, April 30, 2003
Printed in Nigeria

0795-8072/2003 $12.00 + 0.00

BRC 2002062/15210

Nutrient analyses and investigation into the potential of watermelon flesh-juice for wine production.

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(Received August 28, 2002)

ABSTRACT: Flesh-juice of mature ripe fruit of watermelon (*Citrullus lanatus*) containing 6.1% (w/v) reducing, 3.10 Brix 0.153% total nitrogen. 0.393% ash and with a pH value of 5.6 was fermented with three strains of yeast. Two of the yeasts (NCYC 125 and Y271) were bottom fermenting yeasts. All the three yeast strains were found suitable for wine production in the watermelon flesh-juice supplemented with sucrose. While table wines containing 6.0 – 8.8% alcohol and pH values of 4.8 – 4.9 were produced, sensory evaluation of wines showed no difference in the organoloptic acceptability of the wines of 5% level of significance.

Key Words: Watermelon; *Citrullus lanatus*; Wine production.

Introduction

Watermelon (*Citrullus lanatus* (Thumb) mansf) is widely grown throughout the tropics, sub-tropics and arid region of the world (Raymond, 1989). Commercial production of watermelon is centred in USA where the plant have been selected and improved by seeds men and plant breeders.

Watermelon is an annual plant and grows to cover a large area of ground with its sprawling stems because of the ability to survive in relatively dry condition. It has become an important crop in may developing countries especially where arid conditions prevail (Tindall, 1987). Its economic activities is mainly centred around the seeds. Unlike Egusi (*Cucumeropsis edulis*) which also belong to cucurbit family, watermelon has sweet juicy flesh which often serves as delicacy. The flesh amounts to about 65% whole fruit and of this, 95% is water (Burkill, 1985). In West Africa, the plant is cultivated for the seeds and the bulk of the flesh is allowed to waste.

One of the most plausible methods that could be used to process and preserve the watermelon flesh is to ferment it into wines. The objectives of this work was to ferment the juice collected from the flesh into a good and acceptable wine using one commercially available wine yeast and two other wine yeast strains.

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Materials and Methods

Yeast Cultures

The yeast strain NCYC 125 was collected from the Department of Botany and Microbiology, University of Ibadan, Nigeria while the remaining two years strains were collected as previously described (Osho and Odunfa, 1999).

Screening of yeast for wine making was carried out by inoculating, clarified watermelon flesh-juice and free fermentation allowed for two weeks. The presumptive wines produced were assayed on the colour, aroma and bonquet and taste.

Preparation of watermelon flesh0juice and nutrient analyses

Fresh and blemished watermelon fruits were sorted out. The fruits were washed and rinsed many times in distilled water. The fruits were peeled manually with sterile knife and the seed removed. The juice was clarified by filtering it through a sieve of 250µm pore size (Endecotts Ltd., London, U.K.). Sodium metabisulphite was added to the filtrate to give 125 ppm sulfur dioxide, this act as preservative. The filtrate was then stored in the freezer at 4°C until needed. The specific gravity and sugar content of the juice were measured using Amateur Beer Hydrometer (Ellaway Ltd., Edinburgh, U.K.). The total titratable acidity, ash content, total nitrogen and total alcohol, all were measured using standard methods (AOAC, 1980). The trace metals were measured using the atomic absorption spectrophotometer (Perkin-Elmer, 403) and the free amino acid was determined by the method of ROSEN.

Fermentation of watermelon flesh-juice

The must (flesh-juice) which had been stored at 4°C was allowed to attain room temperature and subsequently filtered into a sterile 4-litre conical flask. Sugar (sucrose) was added to the flask to bring the concentration up to 27.7%. The must was warmed in water bath to dissolve the sucrose and re-filtered to remove impurities. The must was then pasterurized at 63°C for 30 min and subsequently allowed to cool to about 45°C for distribution. The must was distributed into 4 sterile narrow-neck 500ml round bottom flasks in 450ml portions and duplicated. They were corked with cotton wool and aluminium foil labelled appropriately. The pitching was done by inoculating the flasks separately according to the label, with 50ml culture of young actively growing isolates of yeast propagated on the watermelon flesh-juice. The cultures were incubated at 30°C for 36 days. Analysis of the fermenting must was carried out at 4 days intervals. The parameters assayed include % alcohol, % sugar, specific gravity, titratable acidity, refractive index, soluble solid and pH.

Wines were assumed produced, when the properties being assayed for, remained constant, the wines were stored in contact with the dead yeast cell for 9 weeks. Lees separation was performed by carefully siphoning off the clear wine from the sediments of yeast cells into sterile wine bottles. The wines were stored at 4°C for two months.

Clarification of the wine was done by filtering the wines through a membrane filter of 0.45µm pore size and 47mm in diameter using a sterile Millipore filtration apparatus. The wines were compared with conventional sweet and dry table wines by a sensory evaluation panel of eight. The scoring methods of Williams (1982) were employed. The wine colour was determined by the modified spectrophotometric method of Gorinsterin et al (1984) mainly to determine on a comparative basis the hue and brightness of the wines.

Results and Discussion

50% of the watermelon (*Citrullus lanatus*) was obtained as the Flesh-juice. Table 1 shows the chemical composition of the watermelon flesh-juice. The relatively high pH obtained in the study is in agreement with the finding of Cooke and Berg (1973). The total nitrogen and crude protein agree with the

recommendation of Palloti et al (1976). The trace metals are similar to the finsings of Tindall (1978) and Amerine (1957) and (1958) in grapes and other fruits.

Table 1: Watermelon flesh-juice analysis.

PARAMETERS	RESULTS
Water	92%
Specific Gravity	1.015
Total Reducing Sugars	6.1%
Percentage of Sugars	7.3%
Total Titratable Acidity	0.25%
Soluble Solids	3.10 °Brix
Extracts	8.30% (w/v)
Refractive Index	1.2290
pH	5.6
Ascorbic Acid	80 mg/L
Amino Acid	0.239 g/L
Total Nitrogen	0.153%
Crude Protein	0.198%
Potassium	72 mg/L
Calcium	180 mg/L
Sodium	102 mg/L
Magnesium	98 mg/L
Zinc	20 mg/L
Iron	20mg/L
Phosphorus	60mg/L
Ash	0.395% (w/v)
Potential Alcohol	4.0

Figures 1, 2 and 3 show the fermentation profiles of the three yeast strains. The alcohol increased from 0 – 8.8% in must containing NCYC 125 at the end of the 16th day, 0-6.0% in must containing Y271 at the end of 16th day, and 0-6.9% in must containing Y276 at the end of the 18th day. The largest amount of residual sugar (11.2%) was found containing Y271. Other parameters such as specific gravity, soluble solids and refractive indices varied directly as the percentage sugar varies. Furthermore, the titratable acidity recorded its highest value of 0.58% in must containing Y271 at the end of 6th day of fermentation while the lowest of 0.38% was obtained in must containing NCYC 125 at the 8th day of fermentation. The pH equally varied directly as the titratable acidity varies.

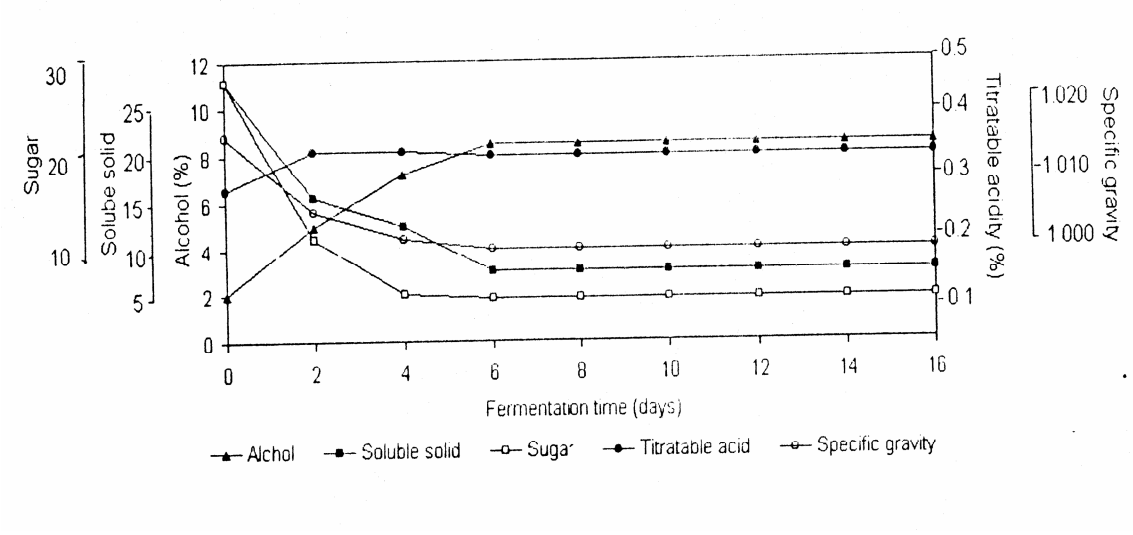

Fig. 1: Fermentation profile of watermelon flesh-juice with the wine yeast NCYC 125.

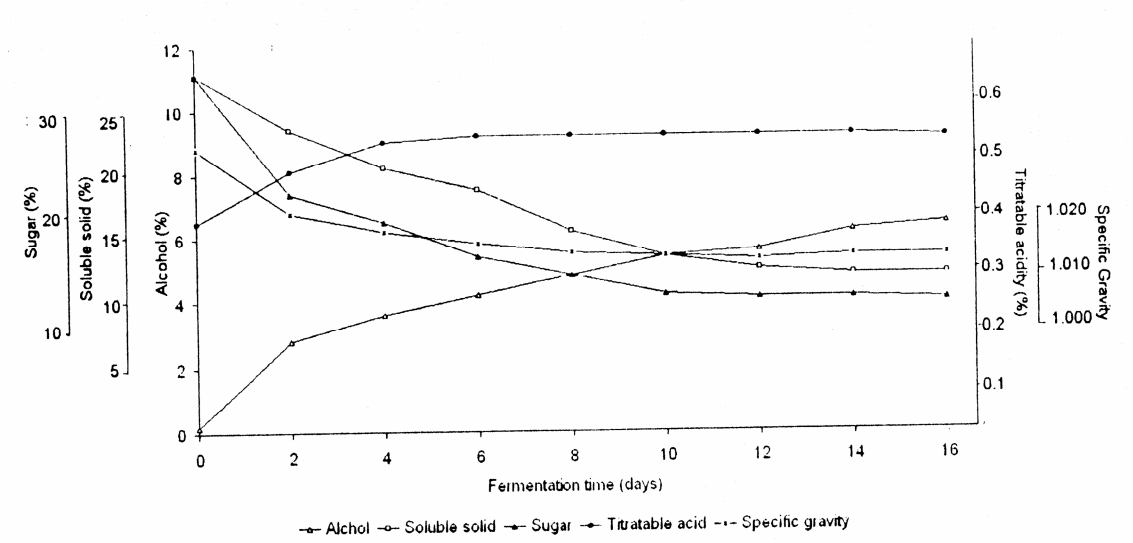

Fig. 2. Fermentation profile of watermelon flesh juice with the yeast Y271

Fig. 2: Fermentation profile of watermelon flesh-juice with the yeast Y 271.

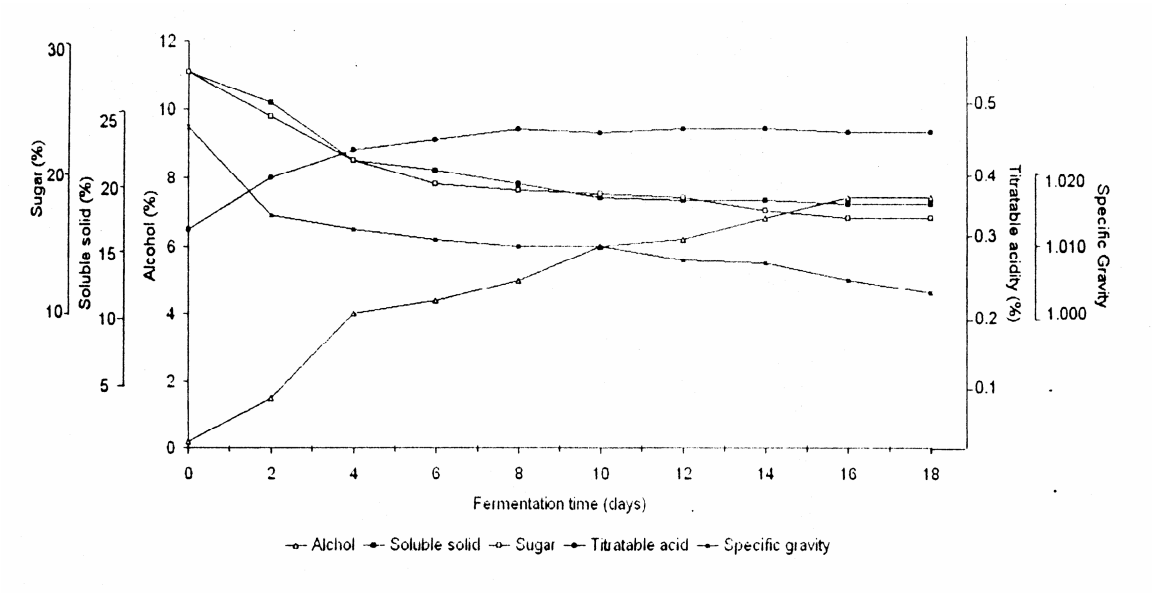

Fig. 3: Fermentation profile of watermelon flesh-juice with the yeast Y 276.

Table 2 shows the chemical composition of the wines at the end of the 18 day fermentation period. The ash content of the wines was generally lower than the values initially obtained in the original watermelon flesh-juice indicating the consumption of some of the minerals salts in the juice by the yeast cells. The organoleptic acceptability of the wines is as presented in Table 3. Statistical estimates show that there was no significant difference between the colour of all the wines at both 15 and 5% levels of significance. Equally there was no significant difference in the odour and smoothness of the wines NCYC 125 and Y276 at 5% level of probability. In odour, NCYC 125 was found superior followed by Y276 wine. IN smoothness, Y271 was superior followed by Y276 wine. For Hedonic and flavour, the wine NCYC 125 was found superior. In taste, NCYC 125 wine was also superior with no significant difference between Y271 and Y276 wines. Furthermore, evaluation of all the wines by statistical analysis revealed that the wines have good flavour but are rather too smooth and generally low in their degree of sharpness. This observation could probably be attributed to the low level of alcohol produced. This type of watermelon wines produced would be very much desired where low level of alcohol is required.

Table 2: Analysis of the white table wine produced with watermelon flesh-juice.

PARAMETER	**NCYC 125 WINE**	**Y271 WINE**	**Y276 WINE**
Alcohol	8.8	6.0	6.9
Specific Gravity	1.005	1.014	1.009
Sugar %	5.6	11.2	8.6
Total nitratable acidity %	0.4	0.6	0.6
Soluble solid (°Brix)	6.2	13	10.3
*Alcohol yield	0.40	0.36	0.36
Extract (%, w/v)	10.4	14.9	15.3
Potassium (mg/L)	17	38	45
Calcium (mg/L)	98	104	104
Sodium (mg/L)	96	94	86
Magnesium (mg/L)	76	76	80
Zinc (mg/L)	14	15	14
Iron (mg/L)	10	15	14
Nitrate (mg/L)	1.32	1.8	0.5
Amino acids (mg/L)	0.103	0.174	0.193
Total Nitrogen (%)	0.043	0.068	0.095
Ash (%)	0.243	0.29	0.27
pH value	4.8	4.9	4.8

Alcohol yield = $\frac{\%\ \text{Alcohol produced}}{\%\ \text{Sugar consumed.}}$

Table 3: Sensory Evaluation Scores.

Parameters	NCYC 125	Y271	Y276	Treatment total
Odour	3.45	2.35	2.75	8.55
Taste	3.25	3.00	3.05	9.3
Sharpness	3.15	3.00	3.20	9.35
Smoothness	3.35	3.65	2.45	9.45
Hedonic & flavour	7.255	6.85	7.00	21.105
Block Total	20.455	18.85	18.45	

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